CRASH DATA RESEARCH CENTER
Calspan Corporation
Buffalo, NY 14225

CALSPAN ON-SITE AMBULANCE CRASH INVESTIGATION

SCI CASE NO.: CA12002

VEHICLE: 2012 FORD ECONOLINE 350 / MEDIX TYPE II AMBULANCE

LOCATION: VIRGINIA

CRASH DATE: JANUARY 2012

Contract No. DTNH22-07-C-00043

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

DISCLAIMER

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. CA12002	*2. Government Accession No.*	*3. Recipient's Catalog No.*	
4. Title and Subtitle Calspan On-Site Ambulance Crash Investigation Vehicle: 2012 Ford Econoline 350 / Medix Type II Ambulance Location: Virginia		*5. Report Date*: June 2012 *6. Performing Organization Code*	
7. Author(s) Crash Data Research Center		*8. Performing Organization Report No.*	
9. Performing Organization Name and Address Calspan Corporation Crash Data Research Center P.O. Box 400 Buffalo, New York 14225		*10. Work Unit No.* *11. Contract or Grant No.* DTNH22-07-C-00043	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		*13. Type of Report and Period Covered* Technical Report Crash Date: January 2012 *14. Sponsoring Agency Code*	
15. Supplementary Note An investigation of the multiple-event crash of a 2012 Ford Econoline 350 Chassis / Medix Type II ambulance.			
16. Abstract This on-site investigation focused on the multiple-event crash of a 2012 Ford Econoline 350 series chassis that was equipped with a Medix Type II ambulance body. The ambulance was traveling southbound on a rural two-lane roadway, occupied by a 21-year-old male driver, an 82-year-old male patient, and a 24-year-old male crewmember. Operating without the use of its emergency warning lights or siren, the ambulance was transporting the patient to a nursing facility after discharge from a local hospital. The ambulance crossed over the center lane line, and its frontal plane impacted the frontal plane of a 2007 Kenworth single unit straight truck. In response to the frontal crash event, the ambulance rotated counterclockwise (CCW) and initiated a one quarter-turn rollover sequence before departing the west roadway edge. This crash resulted in the death of the 21-year-old male driver, who sustained severe traumatic injuries to his lower extremities and abdomen. The patient was transported to a local hospital, where he expired shortly after arrival. The male crewmember was transported to a local hospital and released after evaluation.			
17. Key Words Ambulance Fatal Rollover		*18. Distribution Statement* General Public	
19. Security Classif. (of this report) Unclassified	*20. Security Classif. (of this page)* Unclassified	*21. No. of Pages* 28	*22. Price*

TABLE OF CONTENTS

CALSPAN ON-SITE AMBULANCE CRASH INVESTIGATION
SCI CASE NO.: CA12002
VEHICLE: 2012 FORD ECONOLINE 350 CHASSIS / MEDIX TYPE II AMBULANCE
LOCATION: VIRGINIA
CRASH DATE: JANUARY 2012

BACKGROUND

This on-site investigation focused on the multiple-event crash of a 2012 Ford Econoline 350 series chassis that was equipped as a Type II ambulance (**Figure 1**). The crash resulted in the death of the ambulance's 21-year-old male driver and 82-year-old male patient. The Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) was notified of the crash by the Office of Emergency Medical Services (EMS). The CID forwarded the notification to the Calspan Special Crash Investigations (SCI) team on January 11, 2012 to perform an on-site investigation. The SCI team initiated telephone communication with the investigating law enforcement agency, a Trooper who assisted at the crash scene, and representatives of the State Office of Emergency Medical Services (EMS) Programs. All files and information relating to the case were in the possession of the ambulance agency's legal representation. Cooperation was ultimately established with the ambulance agency's attorney on April 27, 2012, and the on-site portion of the investigation took place April 30-May 1, 2012. This involved the detailed inspection of the ambulance and crash site, with interviews conducted with pertinent parties.

Figure 1: On-scene image of the involved ambulance (*obtained from an online news source*).

The ambulance was traveling southbound on a rural two-lane roadway, occupied by the 21-year-old male driver, the 82-year-old male patient, and a 24-year-old male EMS crewmember. Operating without the use of its emergency warning lights or siren, the ambulance was transporting the patient to a nursing facility after discharge from a local hospital. The ambulance crossed over the center lane line, and its frontal plane impacted the frontal plane of a 2007 Kenworth single unit straight truck. In response to the frontal crash event, the ambulance rotated counterclockwise (CCW) and initiated a one quarter-turn rollover sequence before departing the west roadway edge. This crash resulted in the death of the 21-year-old male driver, who sustained severe traumatic injuries to his lower extremities and abdomen. The patient was transported to a local hospital, where he expired shortly after arrival. The EMS crewmember was transported to a local hospital and released after evaluation.

SUMMARY

Crash Site

The crash occurred on a rural two-lane roadway during midday hours. Weather conditions at the time of the crash were clear with a temperature of 18 Celsius (64.4 Fahrenheit) degrees, 18.5 km/h (11.5 mph) west-southwesterly breeze, and 16% relative humidity. The roadway surface was dry bituminous (asphalt). Both the northbound and southbound travel lanes were 3.2 m (10.5 ft) wide and supported by 0.8 m (2.6 ft) wide asphalt shoulders. They were delineated by a yellow centerline that permitted passing for only the southbound travel direction. The east and west edges of the roadway were bordered by grass swale areas that transitioned into drainage ditches. Speed was regulated by a posted limit of 89 km/h (55 mph) in both directions. In the ambulance's pre-crash southbound direction of travel (**Figure 2**), the roadway followed a -6% grade (downhill). Similarly, the Kenworth's pre-crash northbound direction (**Figure 3**) also followed a -7% grade. The crash occurred in a sag in the roadway between two hills. A Crash Diagram is included on page 24 of this technical report.

Figure 2: Southbound trajectory view of the ambulance's travel path.

Figure 3: Northbound trajectory view of the Kenworth's travel path.

Pre-Crash

A private ambulance transport agency received a request to transport the 82-year-old male from a local hospital to a nursing home facility. The agency scheduled a Basic Life Support (BLS) ambulance to pick the patient up from the hospital at the time of his late morning discharge. The assigned ambulance was staffed by the 21-year-old male driver and 24-year-old male crewmember, both of whom were certified Emergency Medical Technicians (EMTs). They had begun their 12-hour shifts mid-morning and this scheduled non-emergent transport was the first task of their shift.

The ambulance arrived at the local hospital to pick up the 82-year-old male patient. The patient had a history of medical ailments and had been hospitalized for a cardiac surgical procedure. After performing a brief physical exam, the two crewmembers moved the patient onto the stretcher and placed him in an anatomical position of comfort.

They then utilized the lateral harness system to manually restrain the patient to the stretcher, after which they loaded the stretcher into the patient compartment of the ambulance. The stretcher was secured within the longitudinal center area of the patient compartment via a locking pin/clamp mechanism that was anchored to the floor. The male crewmember seated himself in the Captain's Chair, while the driver positioned himself within the driver's seat of the cab. Both utilized the manual restraint systems available for their respective seating positions. The driver then began to operate the ambulance in a non-emergency mode (without use of emergency warning lights or siren) toward the nursing facility.

The expected overall distance of this trip was 56 km (35 mi), requiring approximately 45-50 minutes of travel time. Nearly 40 minutes after its departure from the hospital, the ambulance was traveling southbound on the rural two-lane roadway. The crewmember reported during an interview that he overheard the patient speak, but was unable to discern what was said. Accordingly, he allegedly unbuckled the manual restraint system and began to stand up from the Captain's Chair in order to communicate with the patient. At that time, the left side of the ambulance crossed over the centerline of the roadway.

The Kenworth truck traveled northbound on the rural roadway, crested a hill, and began its descent. The 29-year-old male driver of the Kenworth observed the ambulance traveling southbound descending the opposing hill, and recognized its encroachment into the northbound lane as it crossed the centerline. In response, the driver of the Kenworth initiated avoidance braking with a right steering input in an attempt to avoid a collision as the frontal plane of the ambulance approached the frontal plane of the Kenworth. Avoidance action by the Kenworth was evidenced by the off-center point of impact and its' location within the roadway (**Figure 4**). There was no evidence at the scene to support avoidance action by the driver of the ambulance.

Figure 4: Southward trajectory view of the point of initial impact.

Crash

The first crash event occurred as the frontal plane of the ambulance impacted the frontal plane of the Kenworth in an offset, head-on impact configuration. This impact resulted in severe deformation to the ambulance's frontal plane, and completely separated its left front tire/wheel assembly. As the vehicles crushed to maximum engagement, a counterclockwise (CCW) rotation was induced on the ambulance by the offset configuration of the impact with respect to the vehicles' respective masses. The point of impact and this CCW rotational movement was evidenced by tire and gouge marks at the scene (*refer to **Figure 4** above*), and the ambulance was deflected back toward its original southbound travel lane.

The ambulance rotated CCW and achieved a right side-leading orientation, which created an instability with respect to the vehicle's longitudinal central axis of gravity due to the increasing drag force load on the right side tires. These forces depressed the sidewall of the right front tire, which rolled the bead off the wheel rim and deflated the tire. The exposed outward edge of the wheel contacted the asphalt roadway surface. This contact resulted in abrasions to the wheel rim and a metallic gouge in the roadway surface, located approximately 4.5 m (14.8 ft) south of the initial point of impact. These dynamics instigated a trip-over into a right side-leading rollover (Event 2). The ambulance rolled one quarter-turn (right side-leading) over a distance of 5.3 m (17.4 ft), and departed the right roadway edge. The right plane contacted the soft grass/soil surface of the roadside swale area, resulting in minor right plane damage. The ambulance then slid a short distance to final rest within the negatively sloped swale area, 12.3 m (40.4 ft) south of the initial point of impact (**Figure 5**). At rest, the ambulance was positioned on its right plane, facing east.

Figure 5: Northeast lookback view from the ambulance's final rest position.

Due to the far greater mass of the Kenworth in comparison to that of the ambulance, the Kenworth maintained its forward trajectory toward the right roadway edge. It departed the east roadway edge and entered the roadside area, and subsequently impacted the end of a 41 cm (16 in) diameter steel culvert pipe and gravel driveway embankment with its frontal plane and undercarriage (Event 3). The Kenworth then maintained its forward momentum, displacing the culvert 5.3 m (17.4 ft) northward and reshaping the driveway embankment before coming to final rest. At its final rest position (**Figure 6**), the Kenworth's frontal plane was facing north at a location 45.9 m (150.6 ft) from the initial point of impact.

Figure 6: Southwest lookback view from the Kenworth's final rest position (*note the protruding and displaced culvert pipe*).

Post-Crash

The local emergency response system received multiple calls from passersby providing notification of the crash. Local law enforcement, fire department, and EMS personnel were dispatched to the scene. The ambulance agency's administration was also notified of the crash, and several representatives responded to the scene.

First arriving personnel located the ambulance lying on its right plane within the west roadside swale area, facing east. The driver was mechanically entrapped within the cab due to the severe deformation of the cab and intrusion of frontal components as a result of the first crash event. He did not display any signs of life or have a pulse, and was pronounced deceased.

Within the overturned ambulance, the patient was lying within the area of the right roof side rail at the rear aspect of the patient compartment and the EMT crewmember was located within the area of the right access doors. The stretcher, having released from the locking clamp mechanism and becoming displaced from the antler bracket during the crash sequence, was overturned and positioned partially on top of the patient. Various unsecured medical equipment and supplies were also strewn about the patient compartment as a result of their displacement during the crash.

Emergency response personnel opened the rear loading doors of the ambulance and removed the stretcher. They then immobilized the patient on a backboard and a helicopter immediately airlifted him to a regional trauma center. His condition deteriorated en route to the trauma center, and he became asystolic. All attempts were made to revive him, but the patient was ultimately pronounced deceased shortly after arrival at the trauma center.

The EMT crewmember was assisted from the ambulance by the emergency response personnel. A ground ambulance transported him to a local hospital, where he was evaluated, treated, and released within 24 hours of arrival.

The driver was removed from the cab of the ambulance by the emergency response personnel. This involved an extended extrication utilizing hydraulic emergency rescue tools to disentangle his body from the deformed and intruded frontal components. The roof of the cab was removed to facilitate this process, and the driver's body was removed through the roof of the cab by the Medical Examiner while the ambulance remained on its right plane.

The 29-year-old male driver of the Kenworth was transported to a local hospital by a ground ambulance for evaluation. He was released without injury. The ambulance and Kenworth were towed from the scene by a local recovery service and stored by their respective owners at proprietary facilities. The ambulance was later transferred to a regional vehicle salvage facility by its insurer, where it was located for this SCI investigation.

2012 FORD ECONOLINE 350 / MEDIX TYPE II AMBULANCE

Description

The 2012 Ford Econoline 350 chassis was manufactured in August 2011 and identified by the Vehicle Identification Number (VIN): 1FDSS3EL5CDxxxxxx. A placard confirmed that the incomplete vehicle chassis conformed to all applicable Federal Motor Vehicle Safety Standards (FMVSS) in effect as of its date of manufacture. The chassis was a rear-wheel drive platform powered by a 5.4 liter, V-8 gasoline engine linked to a 4-speed automatic transmission.

The ambulance's chassis (**Figure 7**) had a 351 cm (138.2 in) wheelbase and 4-wheel power-assisted hydraulic disc brakes with anti-lock. At the time of the SCI inspection, the vehicle's electronic odometer reading was unknown due to system inoperability; however, the ambulance agency's owner reported that the vehicle had just surpassed 9,656 km (6,000 miles) prior to the crash. The vehicle manufacturer's recommended tire size was LT245/75R16E, with recommended cold tire pressures of 415 kPa (60 PSI) front and 550 kPa (80 PSI) rear. It should be noted that the ambulance was equipped with an indirect Tire Pressure Monitoring System (TPMS). At time of the SCI inspection, the vehicle was equipped with Hankook DynaPro AS tires of the manufacturer's recommended size at all four axle positions, mounted on the OEM steel wheels. It should be noted that the left front wheel/tire was separated from the vehicle as a result of the crash. Although it was not with the vehicle at the time of the SCI inspection, according to the vehicle's owner, all four were matching tires. The Tire Identification Numbers (TINs) of the three available tires were all T7XD 5JNH 2211. Specific tire data at the time of SCI inspection was as follows:

Figure 7: Front left oblique view of the 2012 Ford Econoline 350 / Medix Type II ambulance.

Position	Measured Pressure	Measured Tread Depth	Restriction	Damage
LF	Unknown	Unknown	No	Unknown
LR	524 kPa (76 PSI)	8 mm (10/32 in)	No	None
RR	510 kPa (74 PSI)	8 mm (10/32 in)	No	None
RF	Flat	9 mm (11/32 in)	No	None (de-beaded)

The interior of ambulance's cab was configured for the seating of two occupants. Both were forward-facing box-mounted seats with manual seat track and seat back recline adjustments, and featured 3-point lap and shoulder safety belt systems for manual restraint. Head restraints were integrated into the seat backs. A frontal air bag system provided supplemental restraint. Between the two seats and beneath the instrument panel's stereo and climate controls was a center console with an array of switches and communications equipment related to the ambulance's emergency response and operations activities.

Medix Type II Ambulance

The Ford chassis was completed as a Type II Certified "Star of Life" ambulance during secondary manufacturing by Medix Specialty Vehicles, Inc. in September 2011. This consisted of modifications to the existing van body, including the insertion of the Medix Silverhawk patient compartment components and the installation of emergency services operational equipment such as warning lights, sirens, and radio communications. The original roof was replaced with a raised, molded-fiberglass shell to provide increased interior height.

A placard confirmed that the Medix Type II ambulance conformed to Federal Specifications KKK-A-1822 in effect on its date of manufacture. This refers to the United States General Services Administration's (GSA) standard for minimum specifications, test parameters, and criteria for design, performance, equipment, and appearance of ambulances in order to display the six-pointed blue star with Rod of Asclepius (Star of Life).

Patient Compartment Module

The Medix patient compartment module fit within the cargo area and increased the vehicle's overall height by 41 cm (16 in). The original dual-rear and 60/40-side access doors remained. The only modifications to the exterior, with exception to the roof, was the addition of emergency warning lights and an additional folding rear step-bumper. The interior of the patient compartment module served as a mobile emergency room for the treatment of emergent medical conditions in a pre-hospital environment (**Figure 8**). It was configured for the seating of up to four crewmembers surrounding a centralized stretcher for the patient, with numerous wall-mounted cabinets, shelves, and a countertop for the storage of medical equipment and supplies. It should be noted that at the time of the SCI inspection, the majority of the salvageable equipment and supplies had already been removed from the vehicle by the parent ambulance agency.

Figure 8: Forward facing view of the patient compartment of the Medix ambulance module.

The patient compartment module's interior cabinetry and structure were constructed of 1.9 cm (0.75 in) plywood. All joints were secured using 4.1 cm (1.625 in) stainless-steel wood screws and/or (1 in) wooden pegs. Interior surfaces were painted and/or covered with 0.15 cm (0.0625 in) vinyl sheeting that was glued to the plywood. The fiberglass ceiling contained 1.4 cm (0.5 in) dual-layer, closed-cell polymer insulation. A network of coated wires and hoses associated with the ambulance module's interior lighting, electrical, oxygen, and HVAC systems was intertwined within the ceiling, floor, and cabinetry construction. Cabinetry doors were of various construction, including 1.3 cm (0.5 in) plywood, 0.3 cm (0.125 in) plexi-glass inlays, and 0.6 cm (0.25 in) plexi-glass sliding doors inset within aluminum frames.

On the left side of the patient compartment were five storage cabinets and one countertop. At the rear aspect was a 57 cm (22.4 in) wide by 97 cm (38.2 in) tall recessed area where EMS equipment, including a stair chair and traction splint, was stored. Forward of this storage area were two 37 cm (14.6 in) tall by 90 cm (30.4 in) wide storage cabinets, one above the other. Forward of these storage cabinets was a 98 cm (38.6 in) long by 27 cm (10.6 in) deep countertop that had 50 cm (19.7 in) of vertical clearance.

Included within the countertop space, and mounted to the wall, were an array of switches for lighting and climate controls, wall-mounted radio communications equipment, oxygen ports, suction equipment, and a 120-V electrical outlet. Beneath the countertop was a 27 cm (10.6 in) tall by 66 cm (26 in) wide storage cabinet. Along the left roof side rail, above the aforementioned storage areas, was a side-by-side pair of 29 cm (11.4 in) tall by 111 cm (43.7 in) wide storage cabinets.

At the forward aspect of the ambulance was a stack of storage cabinets, the cab/module pass-through, and the "Captain's Chair". The Captain's Chair provided seating for one occupant, and was so-named as its location near the communications equipment, the module's lighting and climate controls, and its proximity to the cab with rear-facing overview of the stretcher was frequently the location of the occupant providing administrative leadership for the crew. The seat itself consisted of a 41 cm (16.1 in) square box-mounted seat cushion and a 60 cm (23.6 in) tall seat back mounted to the wall 20 cm (7.9 in) above the cushion. The Captain's Chair was equipped with a lap safety belt for manual restraint.

Behind the Captain's Chair, a column of three storage cabinets was integrated into the bulkhead. These cabinets provided space for the electrical circuitry panels on top, with a locking storage door for a secure middle cabinet. The base cabinet provided storage for an on-board fire extinguisher and roadside safety equipment, such as folding reflective tetrahedrons. Immediately to the right of the storage cabinet column was a pass-through to the cab, which enabled visual and verbal communication between the driver and crew. To the right of this pass-through, and adjacent to the right side doors, was a 65 cm (25.6 in) tall stack of three 57 cm (22.4 cm) wide by 40 cm (15.7 cm) deep shelves for the storage of a portable suction unit, Automated External Defibrillator (AED), and linen. Above the storage shelves, mounted to the bulkhead, was a biohazard sharp objects container.

The 60/40 side access doors occupied the forward aspect of the right plane, adjacent to the bulkhead's stack of storage shelves. Next to the door and extending toward the rear was a 164 cm (64.6 in) long by 38 cm (15 in) deep three-passenger bench seat. The bench seat cushion was mounted to the top surface of a storage cabinet above the right rear axle position, and was equipped with wall-mounted lap belts for manual restraint. Occupying the right rear corner aspect of the patient compartment module's interior was a 116 cm (45.7 in) tall by 34 cm (13.4 in) wide storage cabinet for the large oxygen cylinder. At the time of the inspection, an M-size oxygen tank was secured within this cabinet.

The central area of the patient compartment module remained open and served as the location of the patient stretcher. Affixed to the floor were a forward antler bracket and a rear locking clamp to secure the stretcher in place.

Vehicle Weight/Payload

A placard on the ambulance chassis declared a Gross Vehicle Weight Rating (GVWR) of 4,309 kg (9,500 lb), distributed as Gross Axle Weight Ratings (GAWR) of 1,905 kg (4,200 lb) front and 2,760 kg (6,084 lb) rear. A vehicle weight/payload certification sticker was located on the interior surface of the oxygen cylinder storage compartment within the rear right corner of the patient compartment, placarded by the manufacturer of the Medix module. It declared that the curb weight of the overall vehicle after secondary manufacturing was 3,175 kg (7,000 lb). The curb weight at the axle locations was 1,451 kg (3,200 lb) front and 1,724 kg (3,800 lb) rear.

At the ambulance's date of manufacture, the minimum available payload allowed by the KKK-A-1822 specifications was 680 kg (1,500 lb). According to the vehicle's placard, the calculated actual payload of the completed vehicle was 1,134 kg (2,500 lb). Based on the SCI Investigator's experience and knowledge of EMS equipment and typical ambulance configuration, the estimated combined weight of the EMS equipment and supplies on-board the involved ambulance at the time of the crash was a minimum of 318 kg (700 lb). Using information obtained during SCI interviews, the Investigator calculated the combined weight of the three occupants of the ambulance at the time of the crash to be 295 kg (650 lb). Accordingly, the SCI Investigator concluded that the laden ambulance was not operating in excess of its available payload capacity at the time of the crash.

Exterior Damage

Damage to the exterior of the ambulance from the multiple-event crash was present on the frontal, left, and right planes of the vehicle. Direct and induced damage spanned the entire 174 cm (68.5 in) frontal width from bumper corner to bumper corner and included severe longitudinal deformation (**Figure 9**). Within the damage pattern, direct contact resulted in the disintegration of the grille and both headlight assemblies, with separation of the bumper beam and left front axle as well as deformation to the hood, left front fender, left A-pillar, left front door, and left B-pillar. This resulted in the severe intrusion into the passenger compartment of frontal components (**Figure 10**).

Figure 9: Overhead view of the severe frontal plane damage to the Ford/Medix Type II ambulance.

Figure 10: Left plane of the Ford/Medix Type II ambulance and the Event 1 damage pattern.

Longitudinal deformation associated with the frontal event displaced the left A-pillar and left front door. During the crash, the left front door buckled outward at its center, though the latch remained engaged against the striker. Thus, the left front door was removed post-crash by emergency response personnel using hydraulic rescue tools, resulting in further post-crash deformation to the A- and B-pillars. It should be noted that the left front door was not with the vehicle at the time of the SCI inspection.

Direct contact associated with the Event 1 impact began 30 cm (11.8 in) left of center and extended 57 cm (22.4 in) to the left front bumper corner. It wrapped down the left plane to the sill beneath the fuel-filler cap location, 73 cm (28.8 in) forward of the left rear axle. A residual crush profile was documented to the frame rail ends and to the lower radiator support because the front bumper beam was sheared from its frame rail mounts during the crash. Measured with a Field-L of 70 cm (27.6 in), the crush at the left (C1) and right (C6) frame rail ends was 126 cm (49.6 in) and 26 cm (10.2 in), respectively. At the lower radiator support, the crush profile produced the following measurements: C1 = 116 cm (45.7 in), C2 = 96 cm (37.8 in), C3 = 77 cm (30.3 in), C4 = 66 cm (26 in), C5 = 50 cm (19.7 in), and C6 = 44 cm (17.3 in). Maximum crush was observed to the area of the left front bumper corner, located at the C1 measurement.

The Collision Deformation Classification (CDC) assigned to the ambulance for the frontal (Event 1) damage pattern was 12FYAW6. No WinSMASH calculations were computed because both vehicles were not within the scope of the model's parameters. The Estimated Delta-V was greater than 55 km/h (34.2 mph).

Right plane damage associated with the rollover sequence (Event 2) consisted of minor body surface deformation and abrasions (**Figure 11**). This included an area of frictional abrasions and minimal deformation to the molded fiberglass shell of the ambulance's raised roof, in the typical area of a vehicle's right roof side rail. Surface abrasions were present across the entire right side plane, aligned in a diagonal direction from the front lower corner toward the rear upper corner of the right plane. No significant crush was associated with the minor severity, one quarter-turn rollover event. The CDC assigned to the ambulance for the rollover (Event 2) damage pattern was 00RDAO2.

Figure 11: Right plane of the Ford/Medix Type II ambulance and the Event 2 damage pattern.

Event Data Recorder

The ambulance was equipped with an Air bag Control Module (ACM) mounted to the floor beneath the left front seat cushion. The ACM had EDR capabilities to measure and record a longitudinal, lateral, or rollover crash pulse. A representative of the ambulance agency's legal team removed the ACM through the left front seat cushion prior to the SCI inspection. As such, the SCI Investigator could not image the EDR data. The SCI team worked diligently to achieve cooperation with the ambulance agency's legal team to obtain a copy of the Bosch Crash Data Retrieval (CDR) data file; however, the team's numerous requests were refused.

Interior Damage

The interior of the ambulance, including the Ford chassis' cab and the patient compartment, were thoroughly inspected for crash related and occupant contact damage. However, due to pending legal implications, the SCI Investigator's inspection of the ambulance was restricted to a non-invasive, visual-only inspection monitored by corresponding representatives. Damage to the ambulance's interior was attributed to cab intrusion, occupant contact, Supplemental Inflatable Restraint (SIR) deployment, and displaced components.

The interior of the ambulance's cab sustained significant damage as a result of the crash, including severe intrusion associated with the exterior Event 1 crash forces. The A-pillar was deformed rearward with such magnitude that the upper A-pillar was nearly parallel with the roof side rail and the lower A-pillar area was engaged against the forward aspect of the left front seat cushion. To document the longitudinal displacement of the left A-pillar, measurements were referenced to the right B-pillar of the ambulance and compared to an exemplar chassis cab. These longitudinal measurements highlighted rearward displacements of the left A-pillar (**Figure 12**) of 44 cm (17.3 in) at sill level, 52 cm (20.5 in) at the lower door hinge, 64 cm (25.2 in) at the upper door hinge, 67 cm (26.4 in) at the beltline, and 13 cm (5.1 in) at the junction with the right roof side rail.

Figure 12: Deformation to the left A- and B-pillars of the Ford's cab.

The severe interior intrusion within the ambulance cab was heavily biased to the left side. The entire instrument panel and steering column were displaced longitudinally, such that the steering wheel rim was loosely engaged against the upper aspect of the left front seat back. The floor, pedals, and toe pan were also displaced and intruded longitudinally into the interior. There was gross deformation and deflection to the floor under and surrounding the driver's seat. Due to the rearward displacement of the floor and surrounding components, the left front seat back was deformed forward and was engaged against the bulkhead wall separating the cab from the patient compartment.

Occupant contact points within the cab were located on the knee bolster and instrument panel from interaction with the driver during the crash. These included distributed abrasions and blood transfer; however, due to the removed and unavailable status of the left front door, as well as the prolonged extrication process associated with the removal of the deceased driver's body, the correlation of specific contact points to the occupant's kinematics could not be determined. The severe intrusion of the instrument panel into the front row of the cab is depicted in the crossing-view shown in **Figure 13**.

Figure 13: Structural intrusion into the cab of the Ford.

The ambulance's AS1 laminated windshield was fractured and displaced from its mount by the initial frontal impact event. This event also disintegrated the AS2 tempered left front glazing, which was fully closed at the time of the crash. The remaining AS2 tempered/original tint glazing of the right side and rear-loading doors remained intact and was not damaged during the crash.

Within the patient compartment of the ambulance, interior damage was attributed to occupant and displaced unsecured cargo contact. There was no intrusion into the patient compartment of the ambulance as a result of the multiple event crash, nor did it sustain integrity loss. This damage was present primarily to the interior front, left, right, and top planes. The bulkhead was slightly displaced as a result of induced structural buckling relating to the frontal (Event 1) impact. Occupant contact attributable to interaction with the stretcher occupant included a pattern of pooled blood and hair on the ceiling and right wall above the bench seat, scuffs and abrasions to the rearward-facing surfaces of the bulkhead, and a longitudinal abrasion/depression to the padded corner surface above the countertop on the left interior plane. Contact attributable to the male EMT was limited to loading depressions to the Captain's Chair seat back. These interior contact points are depicted in **Figures 14** and **15**.

Figure 14: Left plane and bulkhead area occupant contact locations within the patient compartment.

Figure 15: Occupant contact and blood transfer on the ceiling and right interior plane of the ambulance.

Manual Restraint Systems

The ambulance's cab was equipped with 3-point lap and shoulder safety belt systems for manual restraint at both seating positions. Each consisted of continuous loop webbing with a sliding latch plate and was fixed in height at its respective B-pillar-mounted D-ring anchor position. The driver's safety belt retracted onto an Emergency Locking Retractor (ELR), while the front right passenger's safety belt retracted onto an ELR/Automatic Locking Retractor (ALR). The ambulance was also equipped with front safety belt buckle pretensioners. The interior of the patient compartment module of the Medix ambulance was equipped with manual lap safety belt systems at all four seating positions. All manual restraint systems within the patient compartment utilized continuous loop webbing and retracted onto ELRs mounted to the patient compartment walls.

Figure 16: Cut portion of the driver's safety belt webbing gathered within the latch plate.

At the time of the SCI inspection, the driver's safety belt webbing was cut at the upper B-pillar and box-mount anchor locations. The latch plate remained engaged within the buckle, with the cut portion of the webbing looped through the belt path (**Figure 16**). The webbing was gathered in the forward aspect of the latch plate, and also displayed stretching along its entire exposed length. This evidence confirmed belt usage by the driver at the time of the crash. The patient compartment belt systems displayed minor to no evidence of historical use; therefore, restraint usage by the male EMS crewmember could not be confirmed or disputed based solely on the post-crash condition of the Captain's Chair lap safety belt system.

Supplemental Restraint Systems

The cab of the ambulance was equipped with a frontal air bag system for supplemental restraint. This system consisted of advanced dual-stage air bags available for the driver and front right passenger, mounted within the steering wheel hub and top instrument panel. Both air bags were installed by the original manufacturer and had not required any service/maintenance prior to the crash. The frontal impact (Event 1) resulted in the deployment of both frontal air bags within the ambulance. Inspection of the driver's steering wheel hub-mounted air bag was limited by the engagement of the steering wheel rim against the left front seat back (**Figure 17**).

Figure 17: Deployed driver air bag within the Ford.

The driver's frontal air bag deployed through the H-configuration cover flaps without damage. In is deflated state, the air bag measured 55 cm (21.7 in) in overall diameter. Contact evidence on the air bag consisting of blood transfer and material abrasions evidenced occupant interaction. The front right passenger's air bag deployed from the top instrument panel-mounted module through the 23 cm (9 in) wide by 7 cm (2.8 in) tall H-configuration cover flaps without damage. In its deflated state, 55 cm (21.7 in) tall by 37 cm (14.6 in) wide air bag extruded 60 cm (23.6 in) rearward from the module. There was a 4 cm (1.6 in) diameter vent port located on each side of the air bag. Due to the unoccupied status of the front right seating position and the restrained status of the driver, there was no occupant interaction associated with the deployed front right passenger's air bag.

Patient Stretcher

The patient stretcher was a 6500 Power-PRO XT Power Ambulance Cot (**Figure 18**) manufactured by Stryker. It was identified by the serial number (S/N): 070140489. Based on this serial number, it was manufactured during January of 2007 and was constructed of a tubular aluminum frame with circumferential weld joints and steel hardware fasteners. The X-frame supporting the mattress platform featured power raise/lower capabilities with infinite height positions between a minimum of 36 cm (14 in) and a maximum of 105 cm (41.5 in). The mattress platform featured 0-73 degrees of positive backrest angular adjustment via a manually controlled gas-pressure cylinder. In a similar fashion, the leg portion featured 15 degrees of positive angular adjustment. Overall dimensions of the stretcher were 58 cm (23 in) wide and 206 cm (81 in) long, and its unladen weight was 57 kg (125 lb). A placard declared that the load capacity limit of the stretcher was 318 kg (700 lb).

Figure 18: The Stryker Power-PRO XT stretcher.

Electrical power for the raise/lower capability was supplied by a removable 24-volt nickel-cadmium (NiCad) direct current battery pack, manufactured by DeWalt. When depleted, the battery was removed from its port and placed in a docking station for automatic charging via a 120 / 220-volt alternating current connection. The Stryker stretcher was equipped with a multi-strap system for manual restraint of its occupant (patient). This multi-strap system included lateral leg, lap, and chest straps that utilized continuous loop safety belt webbing with locking latch plates. It did not include shoulder straps. Exact adjusted length of the straps at the time of the crash is unknown; However, ambulance agency policy requires that all patients must be securely restrained at all times by all straps when positioned on the stretcher. Although heavy historical use masked loading evidence, the observations of emergency services personnel confirmed restraint usage.

Stretcher Anchoring System

The stretcher was secured in place within the patient compartment module via a Ferno-Washington, Inc. Model 175-2 Cot Fastener System. It was manufactured in November 2011, as identified by the manufacturer's S/N: 11N-200352. The system consisted of a forward antler bracket and rearward locking-clamp mechanism. The antler bracket (**Figure 19**) cradled the forward portion (location of the patient's head area) of the stretcher's frame, while the vertically oriented locking mechanism (**Figure 20**) clamped around a pin protruding from the stretcher's lower frame rail. Combined, these two components restricted the lateral and longitudinal movement of the stretcher.

Figure 19: Forward antler bracket of the stretcher anchoring system within the Ford/Medix Type II ambulance.

Figure 20: Locking-clamp mechanism of the stretcher anchoring system within the Ford/Medix Type II ambulance.

Stretcher and Stretcher Anchoring System Damage

During the frontal crash event, longitudinal crash forces induced a forward trajectory to the stretcher (with respect to the patient compartment's floor). The combined mass of the stretcher and its occupant, coupled with the associated longitudinal crash forces, translated through the locking pin and frame to the locking-clamp mechanism and antler bracket. The stretcher's forward frame and guide wheels loaded the antler bracket, which restricted the forward movement of the stretcher. This created a positive moment of inertia to the stretcher, and its rear aspect began to lift vertically. This movement translated longitudinal and vertical forces on the locking clamp, which exceeded the clamp's locking force load capabilities and deformed the forward portion of the clamp vertically (**Figure 21**) as the locking mechanism released. In such a manner, the stretcher's lateral and vertical movement became unrestricted.

Figure 21: Post-crash misalignment of the locking-clamp pin and mechanism.

As the ambulance initiated its right side-leading rollover sequence, the force of gravity acting on the stretcher's mass induced the movement of the stretcher toward the ambulance's right plane. The locking pin departed the locking-clamp opening and the right aspect of the stretcher contacted the rear left-facing aspect of the bench seat base. This contact fractured the plywood structure and deformed the bench seat base 2 cm (0.8 in) laterally (**Figure 22**).

Figure 22: Bench seat base structure deformation from stretcher frame rail contact within the Ford ambulance.

As the rollover sequenced progressed, the displacement of the stretcher's rear aspect from the locking clamp mechanism disengaged the forward guide wheels and frame from the antler bracket. Subsequently, the entire stretcher was displaced toward the right roof side rail as the ambulance came to rest, contacting its displaced occupant and coming to rest on top of him. The stretcher itself sustained only minor damage during the crash sequence, consisting of only the slight angular deformation of the locking pin and frame rail at the pin's mount location. All adjustments and mechanical components were functional.

2012 FORD ECONOLINE 350 / MEDIX TYPE II AMBULANCE OCCUPANTS

Driver Demographics

Age / Sex:	21 years / Male
Height:	165 cm (65 in)
Weight:	140 kg (310 lb)
Eyewear:	None
Seat Type:	Box-mounted, forward facing, with integrated head restraint
Seat Track Position:	Full-rear
Manual Restraint Usage:	3-point lap and shoulder safety belt
Usage Source:	Vehicle inspection
Air Bags:	Steering wheel hub-mounted frontal air bag
Alcohol/Drug Data:	None
Egress from Vehicle:	Removed by emergency services personnel
Transport from Scene:	None
Medical Treatment:	None; Pronounced deceased at scene

Driver Injuries

Inj No.	Injury	AIS 2005/08	Injury Source	Confidence
1	Subdural hemorrhage of the right occipital lobe	Serious (140650.3,1)	Steering wheel rim	Probable
2	Subdural hemorrhage of the right cerebellar hemisphere	Serious (140438.3,6)	Steering wheel rim	Probable
3	Right middle cranial fossa fracture	Serious (150200.3,8)	Steering wheel rim	Probable

4	Bilateral rib fractures (Right 4th, 7th-8th and Left 1st, 4th-8th and 10th)	Serious (450203.3,3)	Steering wheel combination rim/hub	Certain
5	Hemothoraces (Right 50cc of blood, Left < 25cc of blood)	Serious (442200.3,3)	Steering wheel combination rim/hub	Probable
6	Pulmonary Contusions NFS	Serious (441402.3,9)	Steering wheel combination rim/hub	Probable
7	Left open femur fracture (with associated laceration (posterior aspect, 1.3 cm x 7 cm)	Serious (853001.3,2)	Left door panel forward lower quadrant	Probable
8	Pericardial sac contusion	Moderate (441699.2,4)	Steering wheel combination rim/hub	Probable
9	Retroperitoneal hemorrhage	Moderate (543800.2,8)	Safety belt webbing	Possible
10	Bladder contusion	Moderate (540610.2,8)	Safety belt webbing	Probable
11	Left open comminuted radius fracture (with associated laceration, dorsal aspect, 9 cm x 23 cm)	Moderate (752801.2,2)	Left A-pillar	Probable
12	Left open comminuted ulna fracture (with associated laceration, dorsal aspect, 9 cm x 23 cm)	Moderate (753201.2,2)	Left A-pillar	Probable
13	Left anterior shin laceration, 12.7 cm x 28 cm, with exposed skeletal muscle/subcutaneous tissue	Moderate (810604.2,2)	Left lower instrument panel	Probable
14	Upper frenulum laceration (0.6 cm)	Minor (210602.1,4)	Steering wheel rim	Probable
15	Multiple nose abrasions (from 0.6 cm to 1.2 cm)	Minor (210202.1,4)	Driver air bag	Certain
16	Multiple abrasions of the chin (3 ea, 1.2 cm x 0.6 cm; 2 cm x 1.2 cm; 4.4 cm x 2.5 cm)	Minor (210202.1,8)	Driver air bag	Probable
17	Left lower chest abrasions (3.1 cm x 2.5 cm)	Minor (410202.1,8)	Steering wheel combination rim/hub	Probable
18	Right chest contusion (5 cm x 3.8 cm)	Minor (410402.1,1)	Steering wheel combination rim/hub	Probable
19	Center abdomen abrasions (2 ea, 1.3 cm x 0.6 cm)	Minor (510202.1,4)	Safety belt webbing	Probable

20	Bilateral shoulder contusions, (left 1.3 cm x 2.5 cm and right 7.6 cm x 2.5 cm)	Minor (710402.1,3)	Steering wheel rim	Probable
21	Left shoulder semi-circular abrasion (5 cm)	Minor (710202.1,2)	Steering wheel rim	Probable
22	Left elbow abrasion (dorsal aspect, 1.2 cm x 0.6 cm)	Minor (710202.1,2)	Left A-pillar	Probable
23	Left forearm laceration, superior aspect near the antecubital fossa, (6.3 cm x 4.4 cm)	Minor (710602.1,2)	Left A-pillar	Probable
24	Left hand multiple abrasions, (dorsal aspect)	Minor (710202.1,2)	Windshield	Probable
25	Right anterior thigh laceration (14.6 cm x 5 cm)	Minor (810602.1,1)	Left lower instrument panel	Certain
26	Left posterior thigh, linear abrasions, 0.5 cm to 2.5 cm and left posterior calf linear abrasions, 1.9 cm x 0.6 cm	Minor (810202.1,2)	Left front seat cushion and box-mount	Certain
27	Right knee and shin abrasions (ranging from 0.5 cm to 3.8 cm)	Minor (810202.1,1)	Left lower instrument panel	Certain
28	Bilateral ankle and right foot contusions, (left ankle 2 ea. 2.5 cm x 1.3 cm and 3.8 cm x 1.9 cm; right ankle 3.8 cm x 2.5 cm) Right foot 2 ea. 3.8 cm x 3.2 cm and 1.9 cm x 1.3 cm)	Minor (810402.1,3)	Driver foot controls and intruded toe pan	Certain

Source: Autopsy Report

Driver Kinematics

The 21-year-old male driver was seated in the box-mounted seat. The seat track was adjusted to a full-rear position, and he was restrained by the manual 3-point lap and shoulder safety belt system. Although the exact belt positioning is unknown, restraint usage was confirmed by the post-crash condition of the safety belt system during the SCI vehicle inspection.

The driver initiated a sharp forward trajectory in response to the frontal impact event with the Kenworth. His torso and lap loaded the safety belt webbing, and his face contacted the deployed frontal air bag. His knees contacted the knee bolster of the left lower instrument panel. These contacts all resulted in soft tissue injuries. As the vehicles engaged, frontal components of the ambulance deformed rearward while the driver maintained his forward trajectory. His head and upper abdomen loaded through the deployed air bag, deforming the steering wheel rim and inducing head and facial injuries.

The severe longitudinal displacement of frontal components induced the rearward displacement of the left A-pillar, and the instrument panel, toe pan, and floor began to intrude into the available interior space of the ambulance's cab. The driver's knees engaged the left lower instrument panel and its knee bolster, inducing soft tissue injuries. His feet loaded the intruding toe pan, inducing further soft tissue and skeletal injuries to the driver's lower extremities. Frontal components continued to intrude into the cab's interior space as the vehicles achieved maximum engagement. The steering wheel was displaced rearward and vertically, redirecting the driver against the left front seat back and mechanically entrapping his upper torso. This contact and intrusion loading resulted in multiple abdominal, chest, facial, head, and upper extremity injuries.

The intruding left lower instrument panel/knee bolster and toe pan redirected the driver's lower extremities rearward. This movement thrust the driver rearward as his buttocks and thighs depressed the left front seat cushion. These kinematics resulted in integumentary injuries. The lower instrument panel and toe pan engaged the distal anterior aspect of the driver's lower extremities, depressing their posterior aspects against the forward aspect of the left front seat and box mount. This mechanically entrapped his lower extremities and induced multiple injuries.

As the vehicle initiated its CCW rotation, the driver remained entrapped within the driver's seat by the intruded instrument panel and steering wheel. He remained in this position for the remainder of the crash sequence as the vehicle came to rest.

The driver was pronounced deceased at the scene by first arriving emergency response personnel. No efforts were made to revive him. His body was removed from the vehicle by the emergency response personnel through the utilization of hydraulic emergency rescue tools, under the direction of the Medical Examiner.

Captain's Chair Occupant Demographics

Age / Sex:	24 years / Male
Height:	183 cm (72 in)
Weight:	82 kg (180 lb)
Eyewear:	None
Seat Type:	Box-mounted
Seat Track Position:	Not adjustable
Manual Restraint Usage:	None
Usage Source:	Vehicle inspection
Air Bags:	None available
Alcohol/Drug Data:	None
Egress from Vehicle:	Exited vehicle under own power
Transport from Scene:	Ground ambulance to a local hospital
Medical Treatment:	Treated and released within hours

Captain's Chair Occupant Injuries

Inj No.	Injury	AIS 2005/08	Injury Source	Confidence Level
N/A	None	N/A	N/A	N/A

Source: Interview (other: ambulance agency administration); No records of medical treatment

Captain's Chair Occupant Kinematics

The 24-year-old male EMT reported that he was seated within the rear-facing Captain's Chair. This seating position did not featured seat track or recline adjustment capabilities. According to statements made by the EMT, he was seated in a normal posture and utilized the available lap belt for manual restraint during the ambulance's travel. Prior to the crash, he believed that he overheard the male patient attempt to verbally communicate with him. Due to his location and the patient's orientation on the stretcher within the patient compartment, he was unable to discern what the patient had said. The EMT reported that he reached down and unbuckled the lap belt, with the intention of standing up and moving to the patient's side to be able to communicate directly with him. According to the EMT, it was that point in time in which the crash occurred.

The male EMT initiated a rapid rearward trajectory (with respect to his rear-facing orientation) in response to the frontal impact event. His back contacted the seat back cushion of the Captain's Chair seating position. As his back depressed and loaded the seat back cushion, his neck hyper extended rearward and the posterior aspect of his head contacted the bulkhead wall above the Captain's Chair seat back.

As the vehicles reached maximum engagement, the EMT's back and head maintained loading contact with the bulkhead. The male EMT then initiated a left lateral trajectory (with respect to his rear-facing orientation) toward the right loading doors as the ambulance rotated CCW and began its rollover sequence.

The EMT contacted the interior aspect of the molded fiberglass roof shell above the right loading doors with his left flank. The left aspect of his lower extremities contacted the interior surface of the glazing and the exposed metal structures of the right loading doors. He came to rest within this area as the ambulance slid to final rest within in the roadside swale area.

Due to the EMT's position within the ambulance at rest and the displacement of medical equipment, supplies, and the stretcher, the EMT was unable to exit the overturned ambulance. Accordingly, he was assisted from the vehicle upon arrival of emergency response personnel. The EMT was transported to a local hospital by a ground ambulance, and reported that he was released within hours without injury.

Stretcher Occupant Demographics

Age / Sex:	82 years / Male
Height:	Unknown
Weight:	77 kg (170 lb)
Eyewear:	Unknown
Seat Type:	Other seat type (specify: EMS stretcher)
Seat Track Position:	Not adjustable
Manual Restraint Usage:	Lateral harness system
Usage Source:	Vehicle inspection / Interview
Air Bags:	None available
Alcohol/Drug Data:	None
Egress from Vehicle:	Removed from vehicle by emergency services personnel
Transport from Scene:	Helicopter to a regional trauma center
Medical Treatment:	Expired within 30 minutes after arrival

Stretcher Occupant Injuries

Inj No.	Injury	AIS 2005/08	Injury Source	Confidence Level
1	Deep right femoral arterial laceration	820206.3,1	Left interior wall	Certain
2	Large frontal hematoma	110402.1,5	Bulkhead interior wall	Certain
3	Multiple upper extremity lacerations	710600.1,9	Displaced medical equipment/supplies/stretcher	Probable

Source: Interview (other: ambulance agency administration); Medical Records (Emergency Department); Autopsy report

Stretcher Occupant Kinematics

The 82-year-old male patient had been discharged from a local hospital on the day of the crash. He had been hospitalized for 18 days following an aortic valve replacement surgical procedure. His extensive health history included systolic and diastolic heart failure, coronary artery disease, hypertension, cancer, myocardial infarction, gastro-intestinal hemorrhage, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), and chronic kidney disease (CKD).

For ambulance transport to the nursing facility, the patient was positioned semi-Fowler's (an anatomical sitting position of comfort with torso slightly reclined and legs extended forward) on the Stryker stretcher. He was restrained by the lateral multi-strap system, which was adjusted with all loose slack removed. Restraint usage was confirmed by the reports of emergency response personnel and the ambulance agency's internal operations policy.

The male patient initiated a rapid rearward trajectory (with respect to his rear-facing orientation) in response to the severe frontal impact event. His back loaded the reclined back support of the stretcher, and, due to a lack of shoulder restraints, his forward movement (with respect to the stretcher) was unrestricted.

Accordingly, the patient's body slid forward on the stretcher's mattress, creating slack in the stationary lateral restraint straps. As the impact forces increased, the male patient ramped up the back support and separated from the stretcher. His body maintained a trajectory toward the impact force.

As the patient maintained his trajectory, the right aspect of his right thigh contacted the padded corner of the left plane's interior cabinetry, above the countertop. His thigh loaded the cabinetry edge, resulting in the large laceration to the right aspect of his thigh. This contact was evidenced by the deformity to the padded cabinetry edge and associative blood transfer. Immediately following the contact of his right thigh, the patient's head and upper back contacted and loaded the bulkhead wall above the Captain's Chair seating position. This contact resulted in the frontal scalp hematoma and likely multiple other unknown injuries.

As the ambulance progressed through the crash sequence and rotated CCW, the patient remained displaced from the stretcher and in contact with the bulkhead wall. His body was then redirected toward the right interior wall of the patient compartment as the ambulance began its rollover sequence. His head, face, upper extremities, and left flank contacted the ceiling and right roof side rail area, evidenced by multiple patterns of scuffs, blood transfers, and hair/skin tissue deposits. He came to rest within the right roof side rail area above the bench seat on his left flank, with multiple pieces of displaced medical equipment and supplies, as well as the displaced stretcher, positioned on top of him.

The unresponsive patient was removed from the ambulance by emergency response personnel after an extended period of time. This was due to the displaced medical equipment and stretcher on top of the patient and the overturned status of the ambulance at rest. The patient was immobilized on a backboard and removed through the rear loading doors of the ambulance. He was then airlifted from the scene and transported by helicopter to a regional trauma center.

During transport to the trauma center, the patient became pulseless and asystolic. Efforts to revive him were ceased shortly after his arrival at the trauma center. Records from the trauma center's emergency department indicated probable cause of death as hemorrhagic shock from trauma, and the autopsy performed was external examination only.

2007 KENWORTH

Description/Damage

The 2007 Kenworth single unit straight truck was used as a concrete mixer by a local company. Cooperation to inspect the vehicle could not be achieved with the company's legal representation due to pending legal implications. Therefore, the truck's specific size, status at the time of the crash, and damage sustained in the crash remain unknown. The SCI team worked diligently to obtain images of the truck; however, the team's multiple requests were ignored by all parties involved.

Occupant Data

The 29-year-old male operated the Kenworth truck without any passengers. According to available official records, the driver utilized an available 3-point lap and shoulder safety belt for manual restraint. Post-crash, he exited the vehicle under his own power without assistance. A ground ambulance transported him to a local hospital, where he was evaluated and released without injury.

CRASH DIAGRAM